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LEPTOLEPIS NEVADENSIS, A NEW CRETACEOUS FISH

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ABSTRACT—*Leptolepis nevadensis* n. sp., the first known species of the genus from North America, is described from the "Weber conglomerates" east of Eureka, Nevada. The advanced characters of the structure of the fish suggest Cretaceous age.

DR. S. A. BERTHIAUME while on field work in Nevada during the summer of 1939 discovered a deposit containing fish and plant fossils in the so-called "Weber conglomerates" east of Eureka. These beds have not yielded fossil material heretofore. They were originally mapped as Upper Carboniferous, but this age seemed open to question. Hence the present material, since it can be identified, is of some significance in throwing light on the age of the formation in which it occurs. The fish material has been kindly sent to us by Dr. C. W. Merriam. Fortunately the specimens are for the most part well preserved. They indicate the well-known genus *Leptolepis* Agassiz. The structural characters of the Nevadan species suggest that the deposits in which it occurs are Lower Cretaceous in age.

I am indebted to Dr. Chester Stock of the California Institute of Technology for advice and for a critical reading of the manuscript.

DESCRIPTION OF MATERIAL

The material in the present collection consists of several complete specimens and numerous fragments. The species seems abundant in the region, since the different slabs now at hand indicate the presence of a number of additional specimens in part visible on other bedding planes. The material shows an excellent preservation of details especially in the fins and vertebral column. Most of the bones of the head cannot be distinguished with satisfaction. The proportions of the body of this small species have suffered slightly from distortion; the type shows best the normal proportions in this fish. Some of the syntypes have been lengthened in a post-mortem stage. The material is preserved in a siliceous shale, thinly laminated and of a buff to gray color.

Family LEPTOLEPIDAE

LEPTOLEPIS NEVADENSIS David, n. sp.

Figures 1, 2

Holotype.—A specimen 41 + 9 = 50 mm. in length, no. 10138, California Institute of Technology Coll. Vertebrate Paleontology.

Paratypes.—Ten specimens 33 + 7 = 40 to 48 + 10 = 58 mm. in length and a number of more or less fragmentary specimens. All from Cornell University locality 38C.

Diagnosis.—Body 5.75–6.5 mm. in standard length, head 3.6 mm., orbit a little more than 3 in head; 49 to 50 vertebrae; D. = 14 to 15; A. = 9; V = 8, below posterior part of dorsal fin base; P. = 14; C. = 38. Nine hypurals, five below, four above median line; two epurals.

Description.—Body elongate, depth $5\frac{3}{4}$–$(6\frac{1}{2})$ in standard length, caudal peduncle $\frac{2}{3}$ greatest depth. Head $3\frac{3}{5}$ in standard length, elongate $1\frac{3}{5}$ as long as deep. Orbit large (possibly ovoid in shape), slightly more than 3 in head.

The structure of the headbones, in general, does not differ apparently from that described in detail by Rayner (1938). The parasphenoid is always distinct, rising upward toward the front, and situated rather low in most specimens, cutting through the basal part of the orbit. Maxillary with two well-developed supramaxillaries; lower jaw typical for genus, with highly arched dentary. No teeth can be seen. The ceratohyale distinct in several specimens with 10 branchiostegals. Opercular arch as in *Leptolepis*, opercular $1\frac{1}{4}$ as deep as long, with a pronounced diagonal lower border, lower anterior corner sharply pointed.

Vertebrae 34 to 35 + 15 = 49 to 50. Vertebrae pierced by notochord, which is covered by a layer of dark ossified material. The vertebrae constricted in middle, where neural and haemal arches originate, the

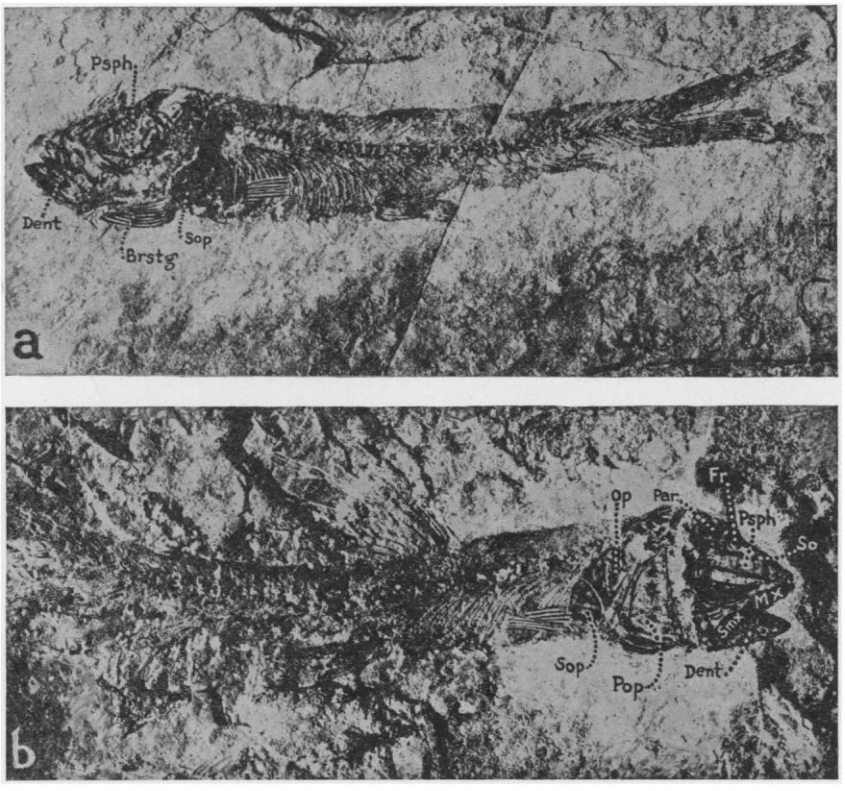

FIG. *1—Leptolepis nevadensis* David, n.sp. *a*, Holotype, no. 10138 Calif. Inst. Tech. Coll. Vert. Paleont.; *b*, no. 10137, ×2. *Fr.*, frontal; *Dent.*, dentary, *Mx.*, maxillary; *Op.*, opercular; *Par.*, parietal; *pop.*, preopercular; *psph.*, parasphenoid; *smx.*, supramaxillary; *so.*, supraorbital; *sop.*, subopercular.

anterior and posterior extremities(zygapophyses?) of the vertebrae projecting into pointed edges. Abdominal neural processes feeble and short, very delicate intermuscular bones lying across; numerous arched and strong ribs extend to ventral border of body.

Structure of tail end of column clearly shown on a small tail fragment, no. 10131 California Inst. Technology Coll. Vertebrate Paleontology (fig. 1). Structure approaches homocerque tail of modern clupeids; only last six vertebrae taking part in structure of tail have prolonged and strong haemal and neural processes. Urostyle slender, pointed; nine hypurals, two more haemal arches prolonged into base of caudal rays; five hypurals below, four above median line; two small epurals, a horizontal rod preceding first caudal fulcra dorsally and ventrally. The haemal processes of the last five vertebrae extend ventrally from the centra for a distance of one-fifth their length and then only are directed posteriorly at a sharp angle, forming enlarged, dagger-shaped hypurals; the end of the ven-

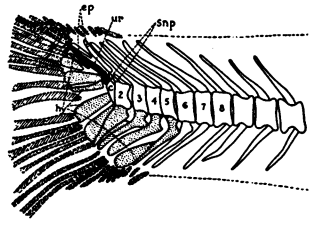

FIG. *2—Leptolepis nevadensis* David, n. sp. Tail end of vertebral column, ×4. *c*, Last vertebral centrum; *ep*, epurals; *hy*, hypurals; *snp*, specialized neural processes; *ur*, urostyle.

tral extension forms a sharp projection pointed forward.

Dorsal rays 14–15: the first two or three short and simple, following rays branched, third or fourth ray longest, two-thirds to three-fourths of head. Dorsal inserted in middle of body or slightly nearer tip of snout. Ventral rays 8: the first strong and simple, fin three-fifths to two-thirds of head, originating below posterior part of dorsal base. Pelvic girdle short, its anterior point not reaching below origin of dorsal. Anal rays 9: longest not longer than ventral, anal fin near to caudal base, distance of anal origin to caudal base 1½ in distance from origin of ventrals to origin of anal. Pectoral with 14 rays, longest ray not longer than ventral, fin situated near ventral border of body. Caudal rays 26+6 pair of fulcra, 38; two middle rays spaced from neighboring rays, prolonged above hypurals. Fin three-fourths of length of head, distinctly furcated, middle rays one-half of longest outer rays.

Body stained dark with an irregular scale-like pattern. No scales are evident.

Affinities of species.—The well-known genus *Leptolepis* Agassiz is widely distributed in Europe and is known from Africa. The genus is first known from the Jurassic (Upper Lias) and continues into the Cretaceous; it has not been reported from deposits younger than Mesocretaceous. Jurassic species of the genus represented by the group of *L. coryphaenoides* Bronn (=L. *bronni* Agassiz), including *L. sprattiformis*, *L. dubius* Agassiz and numerous others, are very different from Cretaceous species. The latter are related to *L. brodiei* Agassiz (see Arambourg 1935, p. 210).

There is no doubt that the *Leptolepis* from near Eureka, Nevada, belongs to the group represented in the Cretaceous. The character that distinguishes most clearly the Cretaceous forms is the transformation of the tail end of the vertebral column. In the Jurassic forms the caudal column is stegoure, while in the Cretaceous forms a progressive transformation takes place to the homocerque type of the living clupeids. The caudal end of the vertebral column in *L. nevadensis* is highly specialized for the genus. It is comparable to the structure seen in *L. congolensis* Arambourg and Schneegans (1935) from the bituminous schists of Coccobeach in French Gabon, and evidently to that of the related species, *L. formosus* Traquair, from the Wealden of Barnissart, Belgium, and of *L. neocomiensis* Bassani from the Cenomanian and Albian, Island of Lesina, Dalmatia. The Purbeckian species *L. brodiei* Agassiz is said to be related to these. Judging from the illustrations, however, the caudal structure of this species seems less specialized. Further evidence of a Cretaceous stage of development of *L. nevadensis* is shown in the following characters: vertebrae of transitional type in degree of perforation by the notochord; the branchiostegals are reduced; the ganoine cover of the scales appears to have been thin; and the dorsal fin is situated over the middle of the body.

As to the immediate affinities of the new species nothing very close seems to be known. The small species with a relatively large orbit may be immature. In its slender body and larger number of vertebrae it differs from any known species of *Leptolepis* (49 or 50). One fragmentary specimen is of much larger size; it may or may not belong to the same species. The structure of the vertebral column, although comparable in degree of transformation of the tail to that in *L. congolensis* Arambourg and Schneegans, shows evident differences in details. The last five haemal processes in *L. congolensis* do not show the distinctive ventral and anterior processes of *L. nevadensis*, the structure and number of hypurals is different, and the first neural process is shortened. Both forms are evidently specialized in different directions. *L. nevadensis*, when compared with the different types of caudal fin-structure shown by the Clupeoidea (Hollister 1936, text figures 3–13), does not show closer relationship to any of these but might be ancestral to them all.

Reports of occurrences of the family Leptolepidae in the Americas are still scanty. A tail, possibly of the leptolepid genus *Thrissops*, has been reported from the Cretaceous of Mexico (Felix, 1890). We can find no reference to the occurrence of *Leptolepis* in the fossil record of North America.

There are two references to occurrences of *Leptolepis* in South America. D'Erasmo (1934) calls attention to a fragment of a head of *Leptolepis* from the Neocomian of Patagonia. The same author (1938) describes an otolith of a member of the Leptolepidae from the Cretaceous of Brazil. He believes that *Haplospondylus clupeoides* Cabrera from the Lower Cretaceous *Leptoceras* strata of Santa Cruz Province, Patagonia, is nearly related to or synonymous with *Leptolepis*.

Because of presence of genera associated with *Leptolepis congolensis* in Coccobeach, which however may have survived *Leptolepis*, Arambourg and Schneegans are able to correlate the Gabon fauna with one of middle or even late Cretaceous age from Bata in Spanish Guinea (Eastman 1912, Weiler 1922). Corresponding Cretaceous faunas have been described from South America—from Bahia, Brazil (Cope 1868, Woodward and Mawson, and Woodward, 1907) and from Riacho Doce in Algaos (Jordan 1910). The age of these South American faunas is not yet assured; they may be Lower or Upper Cretaceous. None of them includes Leptolepid fishes.

Judging from the relationships of *L. nevadensis* to European and African forms, we seem to be justified in regarding the formation near Eureka, whence the specimens came, as of Lower Cretaceous or possibly younger.

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